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POLLUTION OF PRYOR CREEK AND FORT GIBSON RESERVOIR IN THE VICINITY OF PRYOR, OKLAHOMA. APPENDIX E. PROCESS DESCRIPTION AND WASTE SOURCES ALONG PRYOR CREEK

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Cincinnati, Ohio

May 1958

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POLLUTION OF
MUSH CREEK AND FISH KILLS INVESTIGATION
IN THE VICINITY OF
MUSH, OKLAHOMA

APPENDIX A

PROCESS DESCRIPTIONS AND WATER REVIEWS
ALONG MUSH CREEK

U. S. Department of Health, Education, and Welfare
Public Health Service

Region VII Office
Dallas, Texas

Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

May 1958

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Introduction

Appendix E contains descriptions of the processes of the six waste sources along Pryor Creek with particular emphasis on the origins of the wastes. The processes described were those being used in September 1956. Several changes in plant processes were contemplated at the time the survey was being conducted in order to reduce pollution in the Creek. These changes are most likely now in effect.

Pryor Sewage Treatment Plant

The Pryor Sewage Treatment Plant is a complete treatment plant followed by an 8.5 acre lagoon. This plant, without the lagoon, was originally designed to serve a population of 5,000 persons. After trouble was encountered by the plant effluent polluting the upper end of Pryor Creek, the lagoon was added. The plant now serves approximately 8,000 persons.

After passing through a grit chamber, the raw sewage is pumped to a Dorr clarifier for primary settling. This tank is 30 feet diameter and 9 feet deep. Average detention time for the sewage is about 2.6 hours, but detention time is reduced to approximately 1.6 hours during peak flows. If the flow to the primary clarifier is beyond the capacity of the pump, the excess sewage flows to the trickling filter effluent.

From the primary clarifier, the settled sewage flows to a standard rate trickling filter. This filter is 90 feet in diameter and 7 feet deep. Based on the measurements made during the survey, the loading on the trickling filter was 620 lbs./acre foot/day. The flow from the trickling filter goes to the secondary clarifier where the sludge is allowed to settle. This Door clarifier is 25 feet diameter and 14 feet deep. It provides 2.8 hours average detention time or 1.7 hours detention during peak flow hours.

Sludge from the two settling chambers is pumped to either of two digester tanks. These tanks are both 30 feet diameter and 17 feet deep. Provisions are available to recirculate from one tank to the other. Heating coils are available but are not being used. The gas is exhausted to the air. Sludge from the digesters is dried for a short time and then hauled to the Whitaker home where it is used for fertilizer.

The discharge from the secondary clarifier flows to a pump well from which it is pumped to the lagoon. The pump is inadequate and, during periods of peak flow, part of the sewage passes through the overflow pipe and bypasses the lagoon. Both the lagoon effluent and the bypass wastes discharge to a small tributary of Pryor Creek.

John Deere & Co.

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Introduction

The Grand River Chemical Division of Deere & Co. started production of anhydrous ammonia during August of 1954 and urea a short time later.

Ammonia can be used as a raw material for other chemicals or as a fertilizer alone. However, most of the anhydrous ammonia produced at Deere is used in the manufacture of urea. The Deere & Co. urea is sold under the trade name of Vitrea, a 45% nitrogen fertilizer.

Description of Process

Ammonia Synthesis

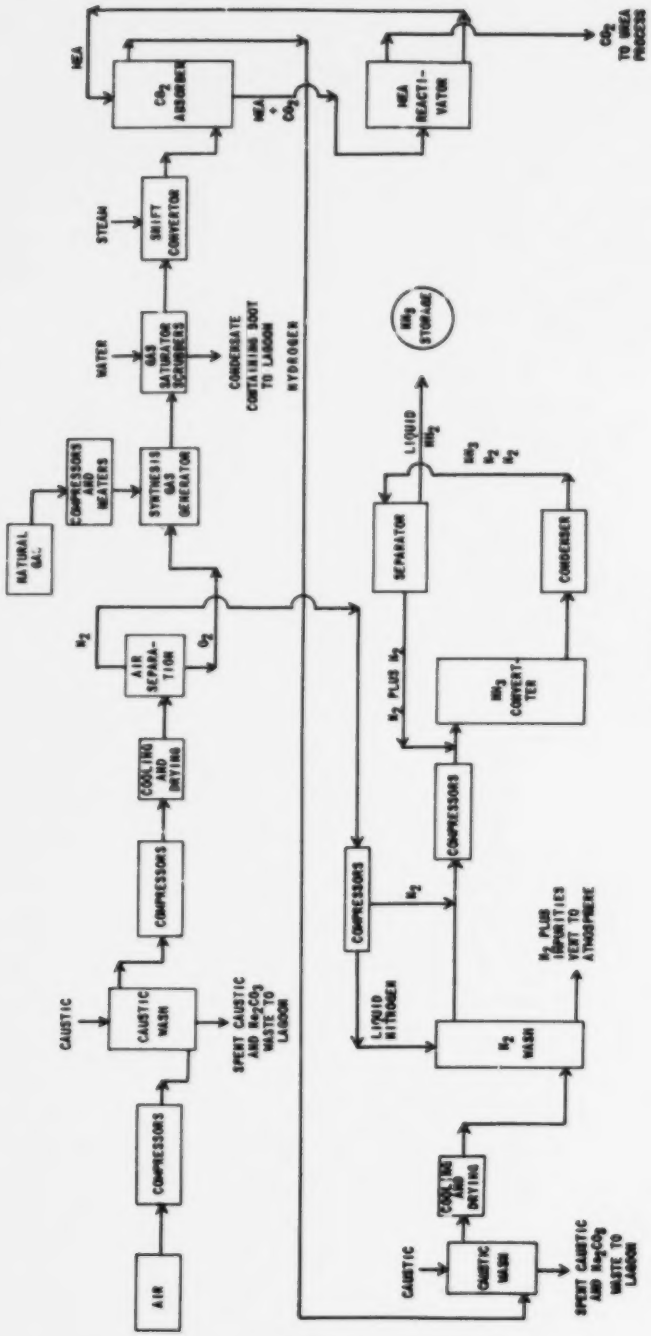
The process of producing anhydrous ammonia involves two distinct operations. First, a gas mixture containing three parts hydrogen to one part nitrogen is prepared. Next, the mixed gases are passed over a suitable catalyst at elevated temperature and pressure, causing them to react, forming ammonia. Figure E-1 shows a flow diagram for this synthesis.

The nitrogen required for ammonia synthesis and the oxygen required for gas processing is obtained from the air. Air consists of 78% nitrogen and 21% oxygen. Hydrogen is obtained from natural gas, which also serves as the source of carbon for the carbon dioxide used in the urea synthesis.

Air from the atmosphere is filtered and then compressed in a two stage compressor to 132 psia. Considerable heat is generated whenever a gas is compressed; hence after each stage of compression, the gas is passed through heat exchangers for cooling. Water is the coolant used in these compressor intercoolers and generally the cooled air passes through separators to remove entrained oil and condensed water.

After compression the air is passed up a tower through a 10% solution of caustic soda. This solution absorbs the carbon dioxide normally present in air. Carbon dioxide and moisture must be removed from the air before it enters the air separation plant to prevent freezing up of the cold equipment.

From the caustic scrubber, the air passes through a separator to remove entrained moisture and then is compressed to 630 psia. The air is next cooled by ammonia refrigeration and dried, after which it



JOHN DEERE & CO.
DIAGRAMMATIC FLOW OF AMMONIA SYNTHESIS
FIGURE E - 1

enters the air separation plant to be fractionated into oxygen and nitrogen. Nitrogen, having a lower boiling point (-323°F.) than oxygen (-297°F.) can be distilled off, leaving the oxygen still liquified.

Natural gas is compressed and preheated before it enters the synthesis gas generator. Here, it reacts with the preheated oxygen from the air separation plant in the presence of temperatures approaching 3000°F. to form hydrogen and carbon monoxide. The hydrogen-carbon monoxide mixture is known as synthesis gas. The Texaco partial oxidation process is employed in the synthesis gas generator because of its efficiency and versatility.

The synthesis gas stream is next saturated with water vapor and scrubbed to remove the soot. After scrubbing, the gases pass to the shift convertor where the carbon monoxide reacts with steam in the presence of an iron oxide catalyst to form carbon dioxide and additional hydrogen. The hot gases leaving the convertor pass through heat exchangers, moisture separators and finally enter the carbon dioxide absorber where the carbon dioxide is removed from the gas stream by absorption in monoethanolamine (MEA), leaving primarily hydrogen in the gas stream.

The MEA, now containing the carbon dioxide, goes to the MEA reactivator where the carbon dioxide is separated from the MEA solution. This is accomplished by reducing the pressure of the system and at the same time applying heat. Any MEA and water carried out with the carbon dioxide stream is removed before the carbon dioxide is delivered to the urea process section.

Hydrogen gas leaving the absorber is washed with a caustic solution to remove the carbon dioxide which is not absorbed by the MEA. The gas stream next passes through a cooler, dryers, and dust filter which remove all moisture and traces of foreign substances, so that carbon monoxide and methane are the only impurities remaining. To remove these last impurities, the hydrogen stream is sent to a nitrogen wash tower where the gas passes countercurrent to a downward flow of liquid nitrogen. Carbon monoxide and methane are liquified under these conditions and pass out the bottom of the tower with the liquid nitrogen and these materials are vented to the atmosphere.

Some of the nitrogen in the tower vaporizes and passes out the top with the hydrogen stream. Additional nitrogen is now added to this stream to bring the hydrogen-nitrogen ratio up to 3.

The hydrogen-nitrogen stream now goes to the 5 stage compressors where the gases are compressed to the ammonia synthesis pressure of 12,500 psi. After passing through a final oil filter, the hydrogen-nitrogen mixture enters the ammonia convertor and a portion reacts to form ammonia. The catalyst used in the convertor is iron which has been triple promoted. The Casale system was used for the design of the Deere Co. ammonia synthesis process.

The ammonia and unconverted gases pass through a condenser, where the gases are cooled, and then to a high pressure ammonia separator, where the liquid ammonia is separated from the synthesis gas stream. The synthesis gas is recirculated to the convertors through an ejector. The ammonia separated from the gas stream goes to the ammonia storage spheres.

Some additional ammonia is obtained from the ammonia recovery unit. This unit receives ammonia bearing gases and liquids from the vent system connected to the flash drums and the evaporators of the urea process. The ammonia is steam stripped from the liquids and the remaining water is sent to the lagoon.

Urea Synthesis

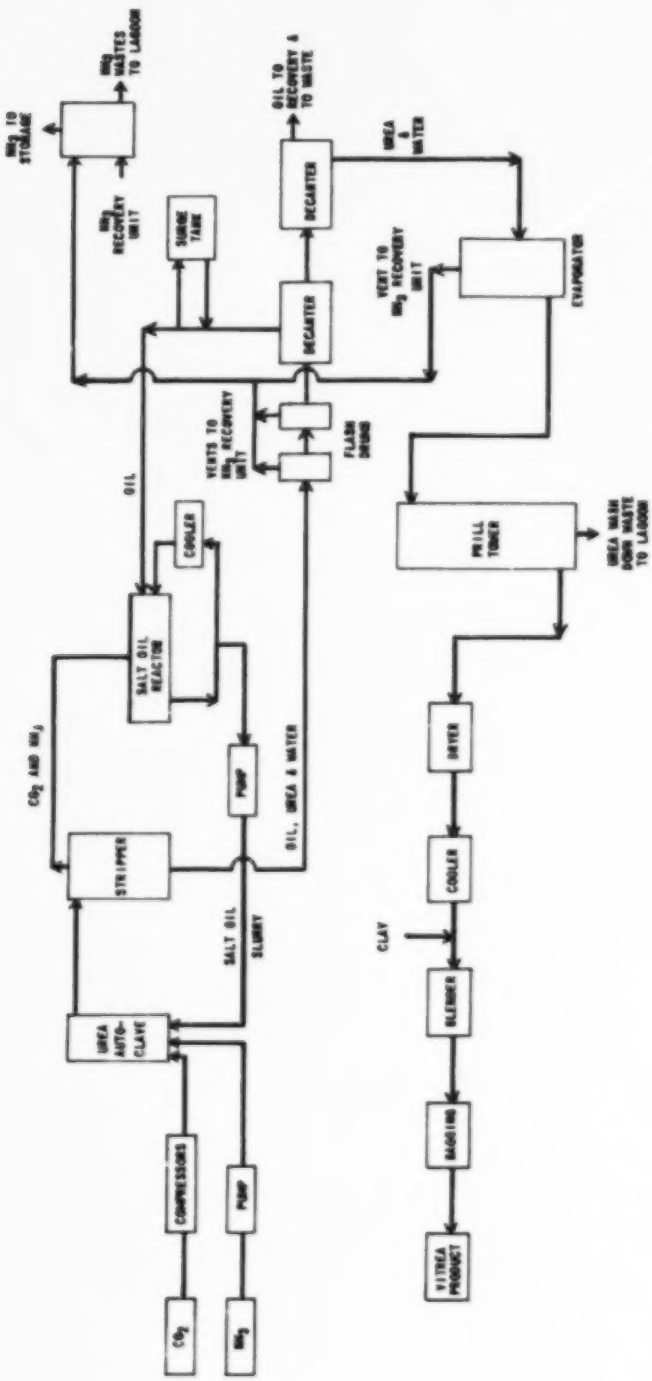
The carbon dioxide used for the urea synthesis is obtained from the monoethanolamine absorber of the ammonia synthesis process. This gas is compressed to a pressure of more than 3000 psi and then passes through towers to remove any sulfur and oxygen before entering the urea autoclaves. The removal of sulfur and oxygen is necessary to keep corrosion to a minimum.

Ammonia is received from the ammonia storage area and the ammonia feed pump discharges it at a pressure of 3100 psi. This ammonia is vaporized in a steam heated preheater after which it enters the urea autoclaves. A flow diagram for the urea synthesis is shown in Figure E-2.

The Pechiney process is used by John Deere & Co. for the urea synthesis. This process uses a total recycle of the unreacted gases. Recycling of the unreacted ammonia and carbon dioxide is accomplished by conversion of the gaseous mixture to solid ammonium carbamate, finely dispersed in a matrix of neutral oil. The carbamate-oil slurry is returned to the reactor system by pumping. In addition to being a carrier for recycle, the oil serves as a heat transfer medium and tends to reduce corrosion and erosion in the autoclave and stripper system.

In the autoclaves, ammonia and carbon dioxide react to form ammonium carbamate, which in turn is partially converted to urea. The mass is continuously released from the top of the autoclave and sent to the stripper. At the reduced pressure in the stripper, the carbamate not converted to urea sublimes to ammonia and carbon dioxide. The overhead, containing the unreacted gases, goes to the salt oil reactor where the gases again react to form carbamate in an oil slurry. This slurry is then pumped back to the autoclaves and the cycle repeated.

The bottoms from the stripper contain oil, urea and water. This stream flows to a flash drum held at atmospheric pressure and then to a



JOHN DEERE & CO.
DIAGRAMMATIC FLOW OF UREA SYNTHESIS
FIGURE E - 2

second flash drum at a reduced pressure. The ammonia released at this stage is vented to the ammonia recovery system.

From the flash drums the urea, oil, and water mixture is pumped to a decanter where the oil is drawn off the top and the urea water solution passes to a second decanter. In the second decanter any remaining oil is separated, with part being bled to waste and part going to recovery where it is held in a tank for a week for adequate separation. The oil from the first decanter is pumped to the salt oil reactor and any make-up of the light petroleum oil is added at the surge tank.

Considerable heat is generated by the reaction of ammonia and carbon dioxide to form carbamate. Therefore, to maintain the proper temperature in the salt oil reactor, a part of the oil is recirculated through a cooler.

Urea and water from the second decanter is pumped to an evaporator where the urea solution is concentrated. The vapors driven off are vented to the ammonia recovery system. The liquid urea is then pumped to the top of the prilling tower where it is sprayed out and the liquid droplets freeze as they fall to the bottom.

The urea pellets are then dried in a gas fired rotary drier, cooled in an air cooled rotary cooler, coated with a clay and oil mixture to keep them from caking, and finally bagged for shipment as Vitrea.

A new process recently started at John Deere & Co. is for the production of feed grade urea. This material is a concentrated protein supplement used in cattle feeds. In this process the urea solution is evaporated and then crystallized. The waste vapors go to the ammonia recovery unit through the vent system.

Waste Sources and Disposal

The sources of liquid wastes at Deere & Co. which enter the lagoon are prilling tower washes, the caustic washes, the water chemically formed in the production of urea, condensates from the ammonia process including saturator scrubber washes, bearing cooling water, the MEA regenerator overhead condensate and oil from miscellaneous points in the plant.

The prilling tower is washed down with a large quantity of water periodically as the urea builds up on the sides. The number of these washes could range from once per day to once per week.

Caustic wash water contains the spent caustic and sodium carbonate. The washer used to scrub the original air is dumped 2 to 3

times daily. The second caustic washer used for the hydrogen stream is dumped about 3 times per week. Wastes from each of the caustic washers have approximately the same composition.

Water is formed in the production of urea.

$$CO_2 + 2NH_3 \longrightarrow \underset{\text{ammonium carbamate}}{NH_2CO_2NH_4} \longrightarrow \underset{\text{Urea}}{NH_2CONH_2} + H_2O$$

Although some of this water flashes off in the flash drums, most of it goes through the decanters and evaporates in the urea evaporators. The overhead from the evaporators is vented to the ammonia recovery system and, after steam stripping most of the ammonia from the water, it is sent to the lagoon. The water from the ammonia recovery system contains about 100 to 400 ppm ammonia.

Individual points have only a small amount of oil discharging to the lagoon but the combination of a number of these points results in a significant quantity of oil. A small amount of oil is bled from the secondary decanter of the urea process. It was stated that experience showed that if all of the oil were recycled, some unknown substance builds up and causes malfunction of the system. Bleeding a small amount of oil prevents this build-up. A small amount of oil also gets into the waste stream from the compressors and other items of machinery. A company official stated that approximately 75% of the oil going to the lagoon is emulsified. When the oil on the surface of the lagoon becomes significant, it is disposed of by burning.

There is a chance that abnormal discharges can end up in the lagoon. This would result with spills, leaks, or if a major item of equipment had to be washed down and material wasted.

Wastes in the process area flow through catch basins in the sewer system and thence to the lagoon. Storm water which falls in the process area flows to the lagoon through this same system, displacing process water in the lagoon by an equal amount. Storm water falling in the warehouse area flows straight to Pryor Creek.

Alkalinity of the lagoon is neutralized by adding sulfuric acid which is obtained from petroleum refinery operations.

The lagoon has a capacity of 9 million gallons with about 30 days retention time of plant wastes, if the entire lagoon is utilized and no short circuiting occurs.

Cooling water for the condensers and machinery is recirculated from the plant through two 16,000 g.p.m. cooling towers. The hexavalent chromium content of the recirculated cooling water is about 30 to 40 ppm. Disposal of any cooling water is made in an underground disposal well with an average discharge to this well being approximately 30 g.p.m.

Disposal of sewage from the plant is made through a septic tank

and sand filters to a small tributary of Pryor Creek.

Plans for future waste control measures are as follows:

1. Neutralization of the alkaline effluent in the plant by means of automatic pH control system. In addition, there will be batch neutralization of caustic dumps. Fresh sulfuric acid will be used and this will eliminate the alkalation acid from petroleum refineries that is now added to the lagoon for the neutralization of the wastes. This system was expected to be in operation by October 1956.

2. Reduction of urea wasted to the lagoon by installing a urea recovery system. The prilling tower wash water and the water from a wet cyclone separator will be sent to this system. The wet cyclone will recover the dust losses in the operations after the prilling. Construction on this system is expected to start by the end of 1956.

3. Improved ammonia recovery system.

4. Improved oil recovery system.

A company official stated that when all of the proposed changes are complete the total lagoon effluent would contain only 100 ppm ammonia instead of the present 1,000 to 3,000 ppm. The high urea content of these wastes would also be reduced in the future.

Bestwall Gypsum Co.

Introduction

The Bestwall Gypsum Co. started production of wallboard in August 1952. The plant normally operates 24 hours per day, 7 days per week. Approximately 100 persons are employed, including 12 office personnel.

Several different types of paper are made, namely Ivory Face paper, Greyback paper, lath wallboard, and roofing dry felt. The plant usually rotates with the first three types of paper, spending 4 to 5 days on each type. The roofing felt is made on a second paper machine and is a continuous operation.

The Ivory Face paper forms the front surface and Greyback paper forms the back surface of gypsum wallboard. The wallboard itself is manufactured at a different plant. Lath paper forms the covering for lathing. Roofing Dry Felt is the basic substance for some roofing materials. When it is saturated with asphalt it forms tar paper. If the felt is saturated with asphalt, then coated with asphalt and surfaced with a certain type of ground rock, asphalt composition roofing is formed. As with the wallboard, only the felt is made at the Pryor plant and the finishing operations take place at another plant.

Description of Process

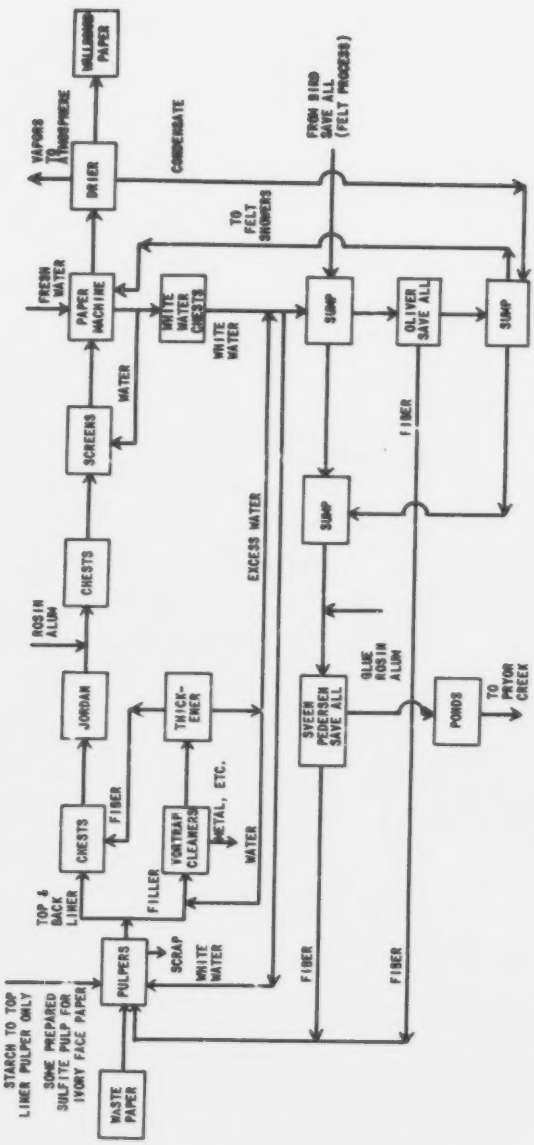
Wallboard Paper

The manufacture of paper consists essentially of matting the fibers of paper pulp together. This is accomplished at Bestwall on a cylinder paper machine. A typical cylinder machine will be described in subsequent paragraphs. An overall flow diagram for producing wallboard paper is shown in Figure E-3.

The main raw material for the wallboard paper is waste paper which arrives at the plant in bales. These bales of paper are dumped into large tanks along with a large amount of water and agitated until the paper is disintegrated into fibers. Three pulpers and one beater are used for this purpose at Bestwall. Baling wire and material not capable of being pulped are removed during the pulping.

A pulper consists of a large tank with an agitator at the bottom. It operates similar to a large size Waring blender which is used in the home.

A beater is a large oval tank containing a central dividing



DESTWALL GYPSUM CO.
DIAGRAMMATIC FLOW FOR
GYPSUM WALLBOARD PAPER
as of 9/12/80
FIGURE E - 3

partition which in effect converts the tank to a continuous channel. In this channel a cylindrical drum is placed. Around the periphery of the drum and more or less parallel to its axis are mounted steel blades which fit closely to similar blades in a concave section of channel flow. The cylinder rotates rapidly and pulls the stock through the blades, breaking up the fiber bundles and combing the fibers in the process.

When Ivory Face paper is being made, about 3 to 4% of prepared sulfite pulp is added to the pulper. A small amount of starch is added to the pulper which is preparing the pulp to be used in the top liner. The top liner is the top mat of fibers in the Ivory Face paper. Coloring materials are added in small quantities, a yellow dye being added to Ivory Face stock and black dye added to the Greyback and lath paper.

When the batch of pulp is at the proper consistency, it is dumped and a new batch added. The pulp for top and back liner is made from good quality scrap paper and can be sent directly to a storage chest. If the pulp will be used for filler, it is sent to the Vortrap cleaner where the slurry moves along a spiral, throwing out heavy particles such as metal. After the cleaner is a horizontal rotary cylinder with a fine screen with which the slurry is dewatered. Most of the separated water is returned to a point before the Vortrap cleaner for dilution purposes, while the fiber materials flow to a storage chest.

From the chests the pulp flows to a Jordan. A Jordan is a machine consisting of a conical shell, inside of which is a close-fitting plug. Many projecting bar type blades, running lengthwise of the shell, are fitted to its inside surface. The outside surface of the conical plug is fitted with projecting blades. The two sets of blades are adjusted to clear by a very minute distance. The plug is rotated rapidly. The pulp stock is forced into the small end of the conical shell, passed through the small space between the plug and the shell, and leaves at the other end. The action of the whirling, closely spaced blades gives the required properties to the pulp.

The pulp is sent to another chest from the Jordan. Before entering the chest, size is added to the paper stock to give the paper a less porous and less absorbent surface. Rosin size is used at Bestwall. Alum is used in conjunction with rosin in order to precipitate the rosin on the fibers.

Just before entering the cylinder paper machine, the paper slurry passes through a flat metal screen which contains a large number of narrow slits of 0.035 inch width in order to remove any large particles. Large particles are returned to the chest before the Jordan. Water from the cylinder vats is continuously recycled to the screens.

After the paper is formed in the cylinder machine, it is dried and then rolled into a large roll ready for shipment to the wallboard

plant. The finished paper contains approximately 5% water content.

Deinking of the waste paper is not practiced at Bestwall because the type of paper produced does not require it. Troubles with slime in the paper machine vats have never developed so that control chemicals are not added for this purpose.

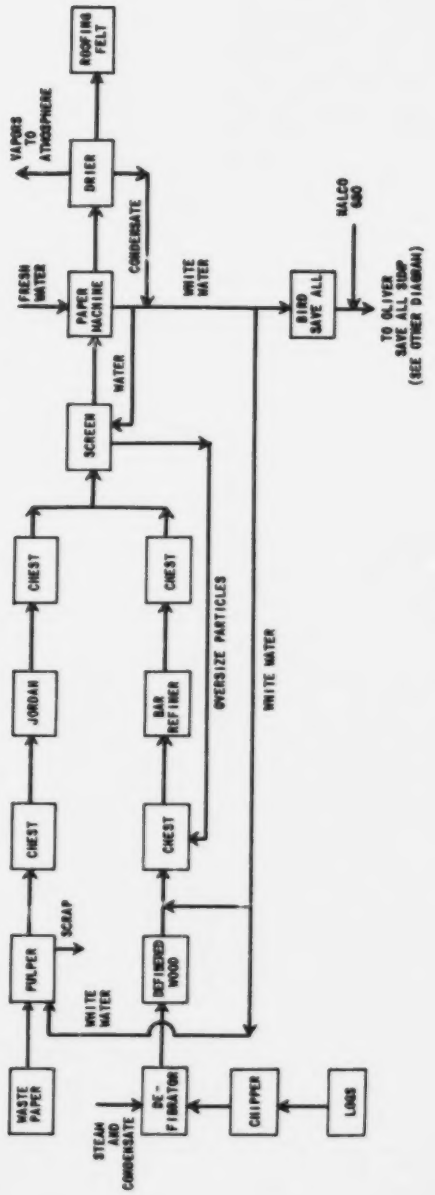
Cylinder Machines

The leading features of a cylinder machine are the cylinder vat and cylinder mold. The mold is a wire mesh covered cylindrical frame which is partially submerged in a vat containing dilute paper stock. Refined paper stock is diluted to low consistencies and fed to the vats continuously. As the stock water strains through the revolving cylindrical screen, a mat of fiber forms on the wire mesh. A moving endless felt belt contacts the cylinder over a small portion at the top. As the cylinder rotates, the mat of fiber passes from the cylinder to the felt because of its greater adherence to felt. The felt belt moves along at a speed equal to that of the periphery of the mold and carries with it the pulp mat. The belt returns over rollers following the passing of the pulp sheet on to dewatering devices. A cylinder machine usually contains several molds and vats, each adding a layer of fiber to the sheet. The wallboard cylinder machine at Bestwall has seven molds. The sheet of fiber is dewatered and pressed smooth by extractor rolls, press rolls, suction rolls, and steam-heated driers and thus formed to a sheet of paper. An extractor roll has a wire mesh face through which water in the mat is squeezed. Press rolls are solid-faced rolls between which one or two felts with the paper sheet between are pressed. A suction roll has a vacuum applied to a section of the interior of the roll. This suction pulls water from the felt and paper mat as they pass over the roll. The felt is dewatered on its return circuit by whippers and felt suction rolls. Felt whippers are multiple-bladed rotors which revolve rapidly. The blades strike the felt and beat the dirt and water from it. Driers are steel cylinders, the inside of which are heated with steam.

The wire of the cylinder mold is flushed clean by a spray of water which is applied in the section of the cylinder between the point on top at which the felt loses contact with the cylinder and the liquid level in the vat. Water from these showers enters the vat and dilutes the stock or passes through the cylinder.

Roofing Dry Felt

In many ways, the roofing dry felt process is similar to the wallboard paper process. One of the main differences is that 50% of the raw material consists of wood. A flow diagram for producing roofing dry felt is shown in Figure E-4.



DESTWALL GYPSUM CO.
DIAGRAMMATIC FLOW FOR
ROOFING FELT
(as of 9/12/66)
FIGURE E - 4

Approximately one-third of the wood used consists of kiln dried Ponderosa pine. This wood is received in chip form from California. The balance of the wood is Oak which is grown locally.

The wood is put through a chipper and then added to the defibrator where it is cooked with steam and steam condensate to break down the fibers. This material is then diluted with white water from the paper machine and held in a chest until ready for the bar refiner.

A refiner consists of movable and stationary discs which are both provided with many projecting blades. The discs are so adjusted that the blades clear by minute distances. The movable disc rotates rapidly and the pulp passes between the discs.

The waste paper is processed through a pulper and a Jordan before being mixed with the pulp from the wood. The combined pulp slurry passes through a screen and then is added to the paper machine.

The paper machine for making the roofing felt is similar to that for making wallboard except that the felt machine has only one cylinder compared to seven cylinders for the wallboard machine. After the felt is formed, it is dried and rolled onto large rolls. Roofing felt contains about 6% moisture content.

Waste Sources and Disposal

Most of the dissolved solids in the plant effluent originate in the raw waste paper. It has been estimated by company officials that the total dry solids have a shrinkage of approximately 10% in the process. Most of this loss consists of metal or unpulpable material which is hauled away in trucks. The balance is in the effluent and settled out in the lagoon or it is in the water being discharged to Pryor Creek.

Scrap and solids not pulped are separated from the process at the pulpers and the Vortrap cleaners. Liquid discharges originate mainly at the paper machines. Additional quantities of liquid come from the thickener and the drier as condensate.

Reuse of water is practiced to a great extent at Bestwall. All of the water added at the pulpers, Vortrap cleaners, and screens is reuse water, with the exception that fresh water is used in the pulpers when Ivory Face paper is being processed. Fresh water is used at the cylinder machines, pump bearings and seals, and for pulping face paper as mentioned.

It was mentioned by company officials that approximately 20% more fresh water is used on face paper than on back paper and that about 20% less fresh water is used on lath paper than on back paper. The felt process uses approximately 40% less fresh water than back paper. paper.

White water from the felt machine flows to a Bird saveall where fibers are settled out and returned to the process. The water from the Bird saveall is treated with Nalco 680, which is an alkaline material used to neutralize wood acidity, and then is added to the white water from the wallboard process.

The total water flows to the Oliver saveall to separate a large portion of the fiber content, the fibers being recycled to the pulpers. Water for the felt showers of the cylinder machine is recycled from the sump after the Oliver saveall.

The Sveen-Pederson saveall was added as a waste control measure after the plant was in operation. Air bubbles are generated in the bottom of this saveall in order to carry solids to the top where they are skimmed off and recycled to the pulpers. Rosin, alum and glue are added to the water before it enters the Sveen. The rosin and alum are flocculating agents while the glue causes the air bubbles to cling to the floc so it can float to the top. Company officials stated that material from the felt operation interfers with the proper operation of the Sveen-Pederson saveall, causing it to operate less efficiently than it would on wallboard alone.

Effluent from the Sveen-Pederson saveall is sent to one of the two remaining settling ponds. A third settling pond is already full of solids. One settling pond has the approximate dimensions of 150' x 90' x 8' while the other is 150' x 90' x 6'. Fiber from these ponds is presently being pumped out to a drying bed, dried and then stored on the plant property. Liquid effluent from the settling pond being used flows through a ditch and down a spillway to Pryor Creek. The spillway was put in to aerate the water.

It is planned, in the near future, to recycle part of the clarified effluent from the Sveen-Pederson saveall to the cylinder machines and hence reduce fresh water usage.

Sewage from the plant is drained to a septic tank and through a sand filter before being discharged to the plant waste stream.

Midwest Carbide Corp.

Midwest Carbide started production in July 1954. The product made here is calcium carbide. Calcium carbide is a basic material for numerous other associated industries and is primarily used for the production of acetylene. The carbide is made by heating coke and quicklime in an electric furnace.

The only water discharged from the operation is cooling water and this in relatively small amounts. The cooling water is generally recirculated through a cooling tower for reuse. Cooling water discharged from the plant flows to a small pond, from which it drains to Sulphur Creek, a tributary of Pryor Creek. Sulphur Creek had no flow at the time of the survey.

National Gypsum Co.

Introduction

The National Gypsum Co. was the first paper plant in Oklahoma, having started production in January 1952. This plant also provides maintenance of the adjacent Ordnance Works which is kept on stand-by. Seventy-two persons are employed at the paper plant.

Three types of paper are produced, Creamface, Greyback, and lath paper. The usual cycle of production is 6 days on Creamface, 6 days on Greyback and then the plant shuts down for a clean-up. Lath paper is made during one run per month.

Description of Process

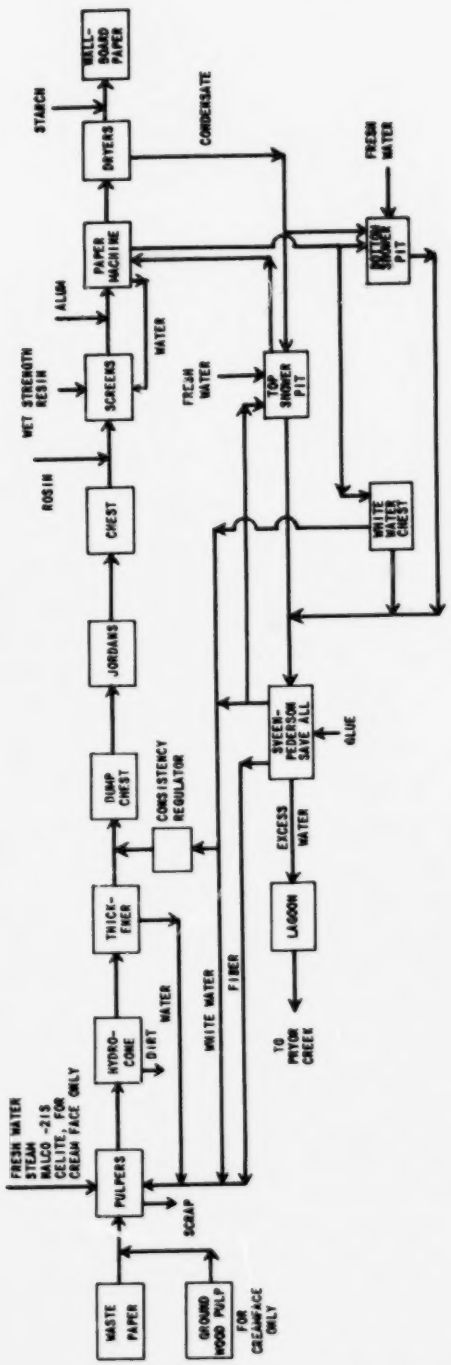
For the most part, the wallboard process at National Gypsum is the same as the wallboard process at Bestwall. A flow diagram for National Gypsum is shown in Figure E-5. National Gypsum uses waste paper only for the raw material except when manufacturing Creamface paper. With Creamface, approximately 20% of the waste paper is replaced with ground wood pulp and sulfite pulp which is bought from outside sources. Deinking of waste paper is not practiced.

Fresh water, steam, and white water are added at the pulpers to cook the paper. Celite, a diatomaceous earth material and Bismark brown dye are also added at this point when Creamface paper is being produced. Except for the winter period, Nalco 21S, a pentachlorophenol compound, is used in the pulp stock to eliminate any slime growths in the vats or other equipment. Material which cannot be pulped is separated in the pulpers and hauled away.

In the Hydrocone, heavy particles such as dirt are separated and discarded. The pulp slurry is next put through a rotary filter to thicken the stock and then stored in a dump chest. The desired consistency is regulated with the consistency regulator by adding white water. The pulp stock is refined in a Jordan, stored in the machine chest, and is treated with rosin size before it enters the machine headbox.

Wet Strength resin, urea formaldehyde, is added to the pulp as it flows through the screen, after which alum is added to precipitate the rosin on the paper fibers.

The National Gypsum paper machine is equipped with eight cylinders. A typical cylinder machine is described under the section



NATIONAL GYPSUM CO.
DIAGRAMMATIC FLOW FOR
GYPSUM WALLBOARD PAPER

FIGURE E - 5

for the Bestwall Gypsum Co.

After the paper is formed in the cylinder paper machine, it is dried and then a starch solution is sprinkled on the stock to give it a smooth, shiny finish. The paper is then formed into a large roll.

Waste Sources and Disposal

Scrap and solids not pulped are separated at the pulpers and Hydrocone. These materials are dumped at a nearby dumping ground. Water discharges originate at the paper machine and a small quantity comes from the dryers as condensate.

Recycle of used water is practiced to a great extent at National Gypsum. White water, the water remaining after the fibers are removed to form the paper, is used in the pulpers, consistency regulator, screens, pumps, and as showers to wash the felt belt and cylinder molds. Fresh water is added at the pulpers and the shower pits.

It was estimated by company officials that the Creamface paper process consumes about 10% more than the Greyback process while the lath uses about 10% less than the back paper.

Water from the paper machine and shower system flows to the Sveen-Pederson savell. Glue is added at this point to give better adherence between the solids and the bubbles. As the solids rise to the surface they are skimmed off and returned to the pulpers. Excess water from the saveall flows to one of the two lagoons of the plant.

The lagoons were completed in May 1956. Each is approximately 500' x 150' x 3'. During clean-up of the equipment and for the first eight hours after start-up, all of the plant effluent flows to the south lagoon. During normal operations, the wastes flow to the north lagoon. After adding the strong wastes to the south lagoon, none of these liquids are discharged for a period of three days. After this period, the top portion is allowed to discharge to Pryor Creek along with the regular discharge from the north lagoon.

The existing waste control measures in the plant are water reuse practices, use of Sveen-Pederson saveall, and the use of the lagoons. In addition, the lagoon effluents flow over small rocks in a bed 210 feet long and 10.5 feet wide before entering the ditch leading to Pryor Creek. This bed allows aeration of the water and microorganisms growing on the rocks might even reduce the biochemical oxygen demand to a slight extent.

It is planned to install additional equipment on the Sveen-Pederson saveall before the end of 1956 which, company officials claim, will result in better solids removal and reduce the solids

being discharged to the lagoon by 40%.

The sewage from the plant is sent to the Grand River Dam Authority Steam Plant sewage system where it receives primary treatment and then flows to Pryor Creek.

Grand River Dam Authority Steam Plant

The GRDA steam plant was constructed during World War 2 to serve the Oklahoma Ordnance Works. At present the plant produces steam power to supplement the GRDA system and provides steam and treated water for local uses. The raw water is obtained from Grand River at the Low Water Dam above the backwater of Ft. Gibson Reservoir.

Waste water discharged to Pryor Creek from the steam plant is primarily cooling water with irregular discharges of filter backwash water, sedimentation basin sludge and regeneration chemicals and wash water from the water softeners. In addition, a small amount of domestic sewage from the employees of the steam plant and National Gypsum Co. receives primary treatment and is discharged to Pryor Creek.

The waste from the GRDA steam plant may be considered dilution water for Pryor Creek as the chemical constituents in this waste water are not important in the pollution problem of the Creek.